Ebooks, Ereaders, and Ebook Device Design

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INTRODUCTION

Ebooks (also: e-books), as a new type of electronic resource, have become an important component of academic libraries, due in part to their potential to enhance teaching and learning (Vasileiou, Hartley, & Rowley, 2009). Along with this, research in library and information science has focused on the adoption (Wexelbaum & Miltenoff, 2012) and design (e.g., Tees, 2010) of portable ebook readers (or ereaders) for academic use, e.g., as regards their usability, the quality of graphic display, and the availability of annotation tools. This chapter defines key concepts related to the design of ereaders and other ebook devices: ebook, ebook device, etext, hypertext, and interaction design. It also summarizes research concerning the design process for ebook devices, organized in terms of user research, design alternatives and building prototypes, and evaluation (cf. Rogers, Sharp, & Preece, 2011). It concludes by identifying directions for future research that take into account the emerging reading practices associated with new digital technologies.

BACKGROUND

Ebooks and Ebook Devices

The term *ebook* (also: *electronic or digital book*) is commonly used in contrast with paper or printed books. Beyond that, it has no consensus definition: It is sometimes used to refer to electronic text in the special form of the digital medium (e.g., Feather & Sturges, 1997; Hughes, 2003) and at other times to the software or hardware used in devices for reading such text. The more precise term *ebook device* refers to an

ereading appliance that comprises three components: *etext* (including *hypertext*), *ebook software*, and *ebook hardware*. Ebook devices include not only *ereaders* (or *ebook readers*), which are portable devices designed solely for reading, but also any devices with *ebook software*, such as laptops and desktop computers. In the design literature, the term ebook is sometimes used to refer to an ebook device. The focus of this chapter is the design of ebook devices intended for ereading. Ebook content and ebook device design for specific applications such as elearning are outside the scope of the chapter.

Etext and Hypertext

Ebooks involve *etext*, text that is displayed on a computer screen or other electronic device. Etext can be either a component of an ebook (e.g., Anderson-Inman & Horney, 1997; Vasileiou et al., 2009) or a broad category that subsumes ebooks (e.g., Bellamy et al., 2001). *Hypertext*, a term coined by Ted Nelson, is a type of etext (Dillon 2004; Willett 2004) that is more than text, in that it contains nodes and links to text and other types of media (McKnight et al., 1996).

In 1945, Vannevar Bush envisioned the prototype of hypertext, the Memex machine, which would enable all intellectual products – books, records, and communications – to be linked to each other by utilizing the principle of association or human cognitive capability (Bush, 1945). Bush's vision inspired two projects in the early 1960s: Ted Nelson's Xanadu system, which envisioned that a new document could be created by linking or bridging existing documents that are mutually exclusive (Nelson, 1974), and Douglas Engelbart's Online System (NSL), which was the first to implement hyperlinked text, diagrams, email, and source code

(Engelbart & English, 1968), although Engelbert did not use the terms 'hypertext' or 'hyperlink.' The early 1980s also saw a number of experimental hypertext and hypermedia programs, many of whose features and terminology were later integrated into the World Wide Web (Cailliau & Ashman, 1999).

History of the Ebook

More directly relevant to the modern ebook device, in 1968, Alan Kay's Dynabook was proposed as "the first prototype of a computer hardware device for reading books online" (Henke, 2003, p. 22). Around the same time, Andries van Dam at Brown University, with assistance from Ted Nelson, started the Hypertext Editing System (HES) and the File Retrieval and Editing SyStem (FRESS) projects; FRESS was used in several courses for reading primary texts online, for annotation, and for online discussions. The term 'electronic book' is thought to have been used first by van Dam (Reilly, 2003). The invention of the ebook is also sometime attributed to Michael Hart at the University of Illinois, who in 1971 launched Project Gutenberg, an initiative designed to create electronic copies of books and make them replicable (Hart, 1992).

In the late 1980s, the idea for the World Wide Web, "the all-time, ultimate e-book" (Lambert et al., 2005, p. 85), was proposed by Tim Berners-Lee. Around the same time, Sony's Data Discman, "the first handheld electronic book reader," was released in 1990 (Lambert et al., 2005, p. 84). In 1998, Gemstar released the Rocket eBook, which resembles a paper book in form and function (Henke, 2003). More recently, the Sony reader and the Amazon Kindle launched a new generation of ebook devices in 2004 and 2007, respectively, that use an epaper technology (Gibson & Gibb, 2011; Golovchinsky, 2008; Nikam & Rai, 2009). Unlike backlit computer displays, epaper displays reflect light like ordinary paper, making them easier to read. Since then, many other ereaders have been released into the market. These include Barnes & Noble's Nook, the iRex iLiad, Samsung's Papyrus, and the Hanlin eReader (for more examples, see Gibson & Gibb, 2011; Zimerman, 2011).

Design Principles of Ebook Devices

Some ebook design researchers claim that Alan Kay's Dynabook concept, although intended as a computer for children, was the ideal ebook device (e.g., Golovchin-sky, 2008; Marshall, Price, Golovchinsky, & Schilit, 2001). The design principles that Kay (2000) proposed for Dynabook were that it should enable children to read, write, draw, play with ideas, access ideas in other places, and communicate with other children. In other words, Kay envisioned Dynabook as a dynamic medium that was interactive, unlike static printed books.

Kay (2002) was inspired for his user interface design by concepts from Jean Piaget's theory of cognitive development (Piaget & Inhelder, 2000), Seymour Papert's work with LOGO, a programing language (LOGO Foundation, 2011), and Jerome Bruner's multiple mentality model (Bruner, 1966). Papert's argument, which was built on Piaget's theory, was that children are able to learn even difficult concepts (e.g., math) when knowledge is presented to them in a form (e.g., images) that is consistent with their cognitive development stage (e.g., the visual stage). Bruner's multiple mentality model holds that human mentality consists of three separate modes of representation – enactive, iconic, and symbolic. Combining these approaches, Kay (2002) came up with the idea that "[d]oing with images makes symbols" (p. 128) as a primary principle of user interface design. That is, people should start by doing concrete things with images and move on to making abstract symbols through them (Kay, 2002). This principle was later concretized into the Graphic User Interface (GUI). Kay (2002) was also influenced by McLuhan's book *Understanding Media* (1964), with its famous quote, "The medium is the message."

Unlike Kay, however, most other ebook device design research has not grounded its designs in explicit reading or learning theories; rather, it has been based mostly on empirical studies, especially those conducted from the perspective of interaction design.

Interaction Design

Ebook designs have been proposed by researchers in different disciplines, including education, computer science, and library and information science. The research described below was carried out by scholars of human-computer interaction, a field that spans these disciplines with design as its primary focus, and that has a strong interest in ebook design. *Interaction design* is "the practice of designing interactive digital products, environments, systems, and services" (Cooper, Reimann, & Cronin, 2007, p. 160).

In the context of ebook devices, interaction design involves defining attributes or properties of compo-

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